Indian wood-destroying termites

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(*With two plates and an Appendix*)

I. Introduction

While all species of termites feed on cellulosic materials including wood, some have a more direct and intimate association with wood. Out of approximately 180 species occurring in the Indian Region (India, Pakistan, Ceylon, and Burma), nearly 58 may be termed wood-destroying. These species may be conveniently divided into two categories, viz. (i) those which are wood-inhabiting and spend either the whole or a part of their life in wood, where they breed (42 species) ; and (ii) those which do not habitually inhabit wood, but are nevertheless its important destroyers whenever opportunity occurs (16 species).

These species (vide Appendix for a list) belong to four families, namely the Kalotermitidae (27 species), Hodotermitidae (1 species), Rhinotermitidae (14 species), all wood-inhabiting ; and the Termitidae (16 species, mostly soil-inhabiting but also wood-destroying).

Brief particulars of the more important wood-destroying species are given here. Several of the wood-inhabiting species prefer relatively moist wood (*Archotermopsis wroughtoni* and some species of the genera *Kalotermes*, *Neotermes*, *Glyptotermes*, and *Stylotermes*), while others prefer dry and seasoned wood (all members of the genera *Cryptotermes*, *Coptotermes*, and *Heterotermes*, and some species of the genera *Kalotermes* and *Neotermes*). Of the latter category, *Coptotermes* and *Heterotermes* have also close connections with the ground, where they live in subterranean colonies. It is fortunate and rather curious that *Neotermes tectonae* (Dammermann), a serious pest of teak trees in Java, is not found in India and Burma, where also teak is grown in abundance.

All the non-wood-inhabiting species concerning us here belong to the family Termitidae and are largely subterranean, although a few of them build earthen mounds above ground such as some species of the genus *Odontotermes*.

Some species destroy woodwork in buildings. Such species may conveniently be divided into two groups, namely : (i) dry-wood species (species which live entirely in dry wood, e.g. beams, pillars, doors, windows, furniture, etc.) ; and (ii) subterranean species (which, while attacking woodwork in buildings, railway carriages, etc., are also subterranean, often breeding underground in the soil). The more important species damaging buildings in the Indian Region are :

Dry-wood species :

1. *Cryptotermes domesticus* (Haviland)—South India and Ceylon.
2. *Cryptotermes dudleyi* Banks—India, Ceylon, and E. Pakistan.

Note.—Ahmad (*Spol. Zylan.* 27(1), p. 35, 1953) has recorded *Cryptotermes cyanocephalus* Light as having been introduced into Ceylon. We have examined these specimens, kindly sent by the Colombo Museum, and find that they are *C. perforans* Kemner.

Subterranean species :

3. *Heterotermes ceylonicus* (Holmgren)—Ceylon.
4. *Heterotermes indicola* (Wasmann)—India and Pakistan.
5. *Heterotermes malabaricus* Snyder—India.
6. *Coptotermes ceylonicus* Holmgren—Ceylon, India.
7. *Coptotermes formosanus* Shiraki—Ceylon.
8. *Coptotermes gaurii* Roonwal & Krishna (*exiguus*[1] auct.)—Ceylon.
9. *Coptotermes heimi* (Wasmann) (syn. *C. parvulus* Holmgren)—India and W. Pakistan.
10. *Odontotermes ceylonicus* (Wasmann)—Ceylon.
11. *Odontotermes feae* (Wasmann)—India, E. Pakistan, and Burma.
12. *Odontotermes redemanni* (Wasmann)—Ceylon.
13. *Hypotermes obscuriceps* (Wasmann)—Ceylon.
14. *Nasutitermes ceylonicus* (Holmgren)—Ceylon.

No precise estimates, in financial terms, of the damage caused by termites to buildings in India are available, but there is no doubt that the damage is very heavy. The principal species in India which damage buildings are : *Heterotermes indicola*, *Coptotermes heimi*, and *Odontotermes feae*. Instances where almost an entire township was thus destroyed by *Heterotermes indicola* have been reported (Roonwal 1955).

II. Particulars of some wood-destroying species

Brief particulars of the more important wood-destroying species, especially with reference to recent work, are given below.

[1] '*Coptotermes exiguus* (Holmgren)', as given by Harris (1961, pp. 156 and 159) is most probably *C. gaurii* R. & K. No valid name '*exiguus* Holmgren' seems to exist (vide also discussion in Roonwal & Krishna 1955, p. 143 ; and Roonwal & Chhotani, 1962, p. 30).

(*a*) *The wood-inhabiting species*

1. **Kalotermes beesoni** Gardner (Plate II)

Occurs in northern India (Uttar Pradesh) and W. Pakistan (Punjab). Some aspects of its biology have been studied by Chhotani (1962*a*, *b*). Emergence of winged imagines occurred in June-August. The proportion of the castes, viz. imagines, soldiers and pseudoworkers, was 1 : 5 : 94. Alates collected in the field, as well as those obtained in laboratory emergences, consisted only of females, the males being entirely wanting, thus suggesting that the colony was breeding by means of parthenogenesis. For a detailed taxonomic description and illustrations of the species vide Roonwal & Sen-Sarma 1960.

2. **Neotermes bosei** Snyder (syn. *N. gardneri* Snyder, vide Roonwal & Sen-Sarma 1960, p. 153).

Occurs in northern and eastern India (Uttar Pradesh and Bengal). Generally attacks dead wood of several species of trees, but infestation may pass on to the living portions of trunks and branches. Some aspects of its biology have been studied by Roonwal & Sen-Sarma (1955). Alates emerge from February to July but mostly in May. Faecal pellets are small (length *c.* 0·9-1·14 mm. ; diameter *c.* 0·5-0·7 mm.), reddish brown and longish, with a hexagonal cross-section. In the galleries, these pellets are often lumped together in masses which are covered with wood-dust. These masses are sometimes as large as 3×4·5 cm. and, being hygroscopic, may serve to condition the humidity inside the galleries. For a detailed taxonomic description and illustrations of the various castes vide Roonwal & Sen-Sarma 1960.

3. **Neotermes greeni** (Desneux)

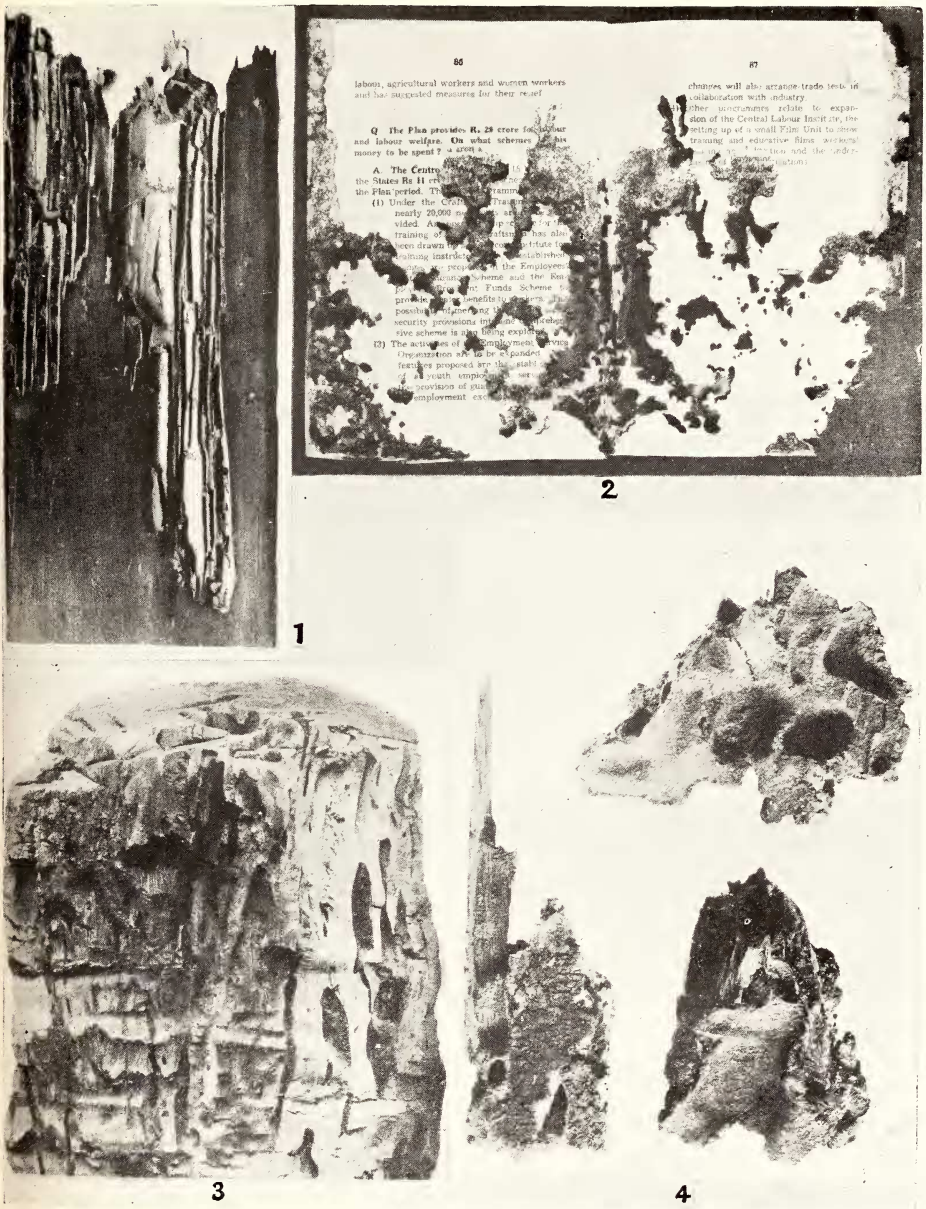
Widely distributed in Ceylon where it is a serious pest of tea and rubber plants, but less so than *N. militaris*. It also infests a number of other trees. For its taxonomic description and illustrations vide Roonwal & Sen-Sarma 1960.

4. **Neotermes militaris** (Desneux)

Widely distributed in Ceylon. Is a serious pest of tea plants whose heartwood it generally hollows out. A single tea bush may harbour a colony of as many as 3000-4000 individuals. Also infests other trees. For its taxonomic description and illustrations vide Roonwal & Sen-Sarma 1960.

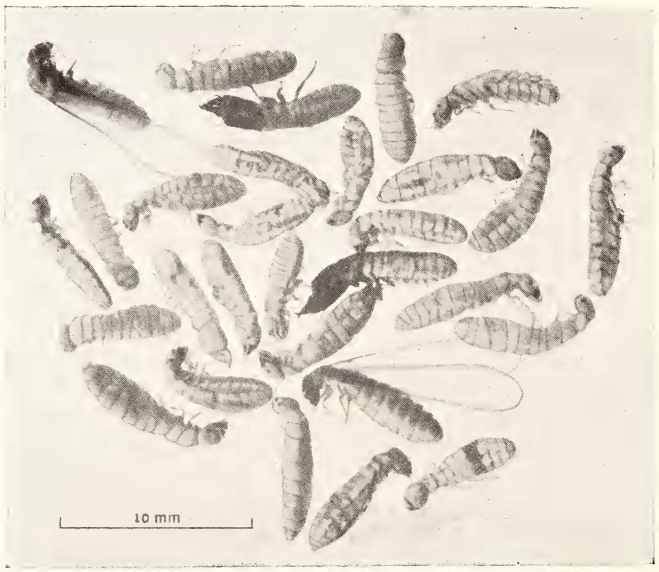
5. **Cryptotermes cyanocephalus** Light

A dry-wood species widely distributed in SE Asia (Java and the Philippines). Recorded as a major destroyer of woodwork in buildings in Ceylon (Harris 1961, p. 158), but see Note under ' Dry-wood species ' at page 355 above.



Photographs showing damage to wood and other cellulosic materials by termites.

Fig. 1. Part of a soft-wood (pine) door-piece, showing damage by *Heterotermes indicola* (Wasmann); Fig. 2. A book damaged by termites; Fig. 3. A piece of wood of *bar* (*Ficus bengalensis* Linn.), showing galleries made by *Cryptotermes havilandi* (Sjöstedt); Fig. 4. Pieces of wood from a log of unknown species almost completely eaten up by *Odontotermes feae* (Washman), and covered by it with earth coverings and fillings.



Upper figure: *Kalotermes beesoni* Gardner. Imagos (alates) soldiers and pseudoworkers.

Lower figure: *Coptotermes heimi* (Wasmann). Imagos (alates), soldiers and workers.

6. **Cryptotermes domesticus** (Haviland)

A dry-wood termite, widely distributed in south east Asia (India and Ceylon to Indonesia and Formosa, etc.). Is a serious pest of woodwork in houses in Ceylon and Malaya.

7. **Cryptotermes dudleyi** Banks

A most widely distributed dry-wood species—India to New Guinea ; and Central and South America. Is a serious pest of woodwork in houses, etc.

8. **Cryptotermes havilandi** (Sjöstedt) [syn. *C. bengalensis* (Snyder)] (Plate I)

A dry-wood termite widely distributed from India to Africa and the West Indies. Species of *Cryptotermes* are generally distributed in coastal areas, many being introductions. But Chhotani (1963) has recently recorded *C. havilandi* from the interior of India (Madhya Pradesh).

9. **Glyptotermes dilatatus** (Bugnion & Popoff)

Occurs widely in Ceylon. Is a serious pest of two economic plants, tea and rubber.

10. **Archotermopsis wroughtoni** (Desneux)

Western Himalayas (Hazara and Kashmir to Kumaon) at altitudes of 2800-9000 ft. above sea-level. Attacks and lives in dead logs and stumps of conifers (pines and deodar). Its morphology and biology was studied long ago by Imms (1919).

11. **Heterotermes** spp. (Plate I)

Members of this genus are subterranean, but attack dry wood above ground in houses and elsewhere, being able to reach such wood by means of long surface-galleries which they construct. Four species of *Heterotermes* are known in the Indian Region, all of them pests of woodwork in houses. The most important species are *H. ceylonicus* (Holmgren) in Ceylon, and *H. indicola* (Wasmann) and *H. malabaricus* Snyder in India. Roonwal (1955) records an instance in which the township of Sri Hargobindpur in the Punjab was partially abandoned a few years ago due to the serious infestation of beams and other woodwork in houses by *H. indicola*.

12. **Coptotermes** spp. (Plate II)

Like *Heterotermes*, the genus *Coptotermes* is a subterranean termite which reaches dry wood above ground, as in houses, railway carriages, etc., and does serious damage. Eight species are known from the Indian Region (vide the recent revision by Roonwal & Chhotani 1962*a*, where

taxonomic descriptions and illustrations are given). The more important species are discussed below briefly.

(i) *Coptotermes ceylonicus* (Holmgren) : Southern India and Ceylon. A pest of tea and rubber and also attacks dry wood.

(ii) *Coptotermes gaurii* Roonwal & Krishna (*exiguus* auct.) : Ceylon. A serious pest of tea plants.

(iii) *Coptotermes formosanus* Shiraki : A species which is widespread (Ceylon, Formosa, S. China, Japan, Hawaiian Is., U.S.A., and S. Africa). A pest of tea and rubber, and also attacks dry wood.

(iv) *Coptotermes heimi* (Wasmann) (syn. *C. parvulus* Holmgren) (Plate II) : All over India and West Pakistan where it is very common. Is a serious pest of woodwork, furniture, etc. in houses and elsewhere. Also known to destroy electric-wire casing, railway coaches, etc. Our knowledge of its biology has been summarised by Roonwal (1959). It is known to attack the dead wood of a large number of trees. Swarming of winged imagines generally occurs at dusk and early night (*c.* 6-10 p.m.). The season of swarming is spring and early summer (March-May) in the more humid areas (W. Bengal, Orissa, and Bombay) and during the monsoon (June-August) in the drier parts (Uttar Pradesh). The nest is made of semi-porous material in dead wood, sometimes even in railway carriages.

(b) The non-wood-inhabiting species

1. **Globitermes audax** Silvestri (syn. *G. birmanicus* Snyder)
Burma. Attacks forest trees. Little is known about its biology.

2. **Microcerotermes heimi** Wasmann

Species of *Microcerotermes* are characterized by the inner margin of the mandibles being serrated like a saw instead of toothed. Nearly 20 species are known from the Indian Region. The most common one is *M. heimi*, occurring in Assam, south India, and Ceylon ; it lives chiefly in logs etc. in forests and makes large globular carton-nests.

3. **Odontotermes** spp.

Species of this genus are among the most common termites in the Indian Region, a few species building earthen mounds. The more important species are discussed below.

(i) *Odontotermes ceylonicus* (Wasmann) : Ceylon. A major pest of woodwork in buildings in Ceylon (Harris 1961, p. 159).

(ii) *Odontotermes feae* (Wasmann) (Plate I) : India, E. Pakistan, and Burma. One of the most destructive termites for woodwork in buildings. Also attacks and kills *Eucalyptus* seedlings in nurseries. No mound is formed as a rule but this happens occasionally (vide Roonwal &

Chhotani 1962*b*). Winged adults swarm out at the beginning of the monsoon.

(iii) *Odontotermes obesus* (Rambur) : The most common mound-building termite in the greater part of India except the south. Attacks moist woodwork and other cellulosic materials (books, textiles, etc.) in houses particularly during the rainy season. But as a pest of dry wood in buildings does not seem to be important. Builds earthen mounds which may rise as high as 2·6 m. (*c.* 8·7 ft.) high. For its mound-structure, vide Roonwal (1958*a*, 1962*b*). For destruction of mound-colonies, vide Roonwal (1951) and Roonwal & Chatterjee (1962).

(iv) *Odontotermes parvidens* Holmgren & Holmgren : All over India. A large species commonly attacking the bark of trees. Was responsible for the killing of plantation teak in Uttar Pradesh (Roonwal 1954) by eating the bark and producing a sort of girdling effect. No mound is built ; nesting occurs underground. Swarming of winged alates occurs in March from small holes in the ground.

(v) *Odontotermes redemanni* (Wasmann) : Peninsular India, Bengal, and Ceylon. Builds earthen mounds as high as those of *Odontotermes obesus*. Is destructive to woodwork in houses, especially in the wet season.

4. **Microtermes obesi** Holmgren (syn. *M. anandi* Holmgren)

A small, widely spread species in India and Ceylon. Often occurs in association with *Odontotermes obesus* in the mound of the latter and in nest-areas of *O. feae*. Does not occur in buildings but attacks logs and dead wood in forests, as well as growing crops such as sugarcane, wheat, millets, etc. (vide Roonwal 1958).

5. **Nasutitermes ceylonicus** (Holmgren)

Ceylon. Is a major pest of woodwork in buildings in Ceylon (Harris 1961, p. 159).

6. **Hospitalitermes birmanicus** (Snyder)

Burma. Attacks saplings. Like other members of the subfamily Nasutitermitinae, the soldiers are characterized by a nasute process in the front part of the subglobular head-capsule and by minute, non-functional mandibles.

III. Control

The destruction and control of wood-destroying termites is a difficult task, mainly because of the difficulty of reaching the population inside the affected timber. The best course is to build houses according to anti-termite designs and to use chemically treated wood (coaltar creosote is very effective). The use of naturally resistant timbers, e.g. heartwood

of teak, is also helpful. Some of the effective control methods devised in recent years in India against subterranean termites may be mentioned briefly.

Control in mounds. Pouring suitable quantities of water-emulsions of some of the chlorinated hydrocarbons (benzene hexachloride, aldrin, and dieldrin) completely destroys mound-colonies in less than a week (Roonwal 1951 ; Roonwal & Chatterjee 1962).

Control by soil treatments (mud-wall poisoning). Laboratory experiments indicate that, if the mud used to plaster huts in villages is mixed with small quantities of benzene hexachloride, effective protection to the super-structure (roof etc.) of bamboo and wood is obtained up to about two years (Roonwal, Chatterjee & Thapa 1962).

IV. Summary

Out of nearly 180 termite species occurring in the Indian Region about 58 destroy wood. Of these, 42 commonly inhabit wood ; the remainder, while not commonly inhabiting wood, nevertheless are important destroyers of wood. They belong to the families Kalotermitidae (27 species), Hodotermitidae (1 species), Rhinotermitidae (14 species), all wood-inhabiting ; and Termitidae (16 species), soil-inhabiting.

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Appendix

List of Indian wood-destroying termites

(a) Species which commonly inhabit wood

Family I. Kalotermitidae

Subfamily Kalotermitinae

1. *Kalotermes beesoni* Gardner
2. *Kalotermes jepsoni* Kemner
3. *Kalotermes pintoi* Kemner
4. *Neotermes andamanensis* Snyder
5. *Neotermes artocarpi* (Haviland)
6. *Neotermes assmuthi* Holmgren
7. *Neotermes bosei* Snyder (syn. *N. gardneri* Snyder)
8. *Neotermes buxensis* Roonwal & Sen-Sarma
9. *Neotermes fletcheri* Holmgren & Holmgren
10. *Neotermes greeni* (Desneux)
11. *Neotermes kemneri* Roonwal & Sen-Sarma
12. *Neotermes magniferae* Roonwal & Sen-Sarma
13. *Neotermes megaoculatus megaoculatus* Roonwal & Sen-Sarma
14. *Neotermes megaoculatus lakhimpuri* Roonwal & Sen-Sarma
15. *Neotermes microculatus* Roonwal & Sen-Sarma
16. *Neotermes militaris* (Desneux)
17. *Neotermes pishinensis* Ahmad
18. *Cryptotermes cyanocephalus* Light
19. *Cryptotermes domesticus* (Haviland)
20. *Cryptotermes dudleyi* Banks
21. *Cryptotermes havilandi* (Sjöstedt) (syn. *C. bengalensis* Snyder)
22. *Cryptotermes perforans* Kemner
23. *Glyptotermes almorensis* Gardner
24. *Glyptotermes ceylonicus* (Holmgren)
25. *Glyptotermes coorgensis* Holmgren & Holmgren
26. *Glyptotermes dilatatus* (Bugnion & Popoff)
27. *Glyptotermes minutus* Kemner

Family II. Hodotermitidae

Subfamily Termopsinae

28. *Archotermopsis wroughtoni* (Desneux)

Family III. RHINOTERMITIDAE

Subfamily (i) Heterotermitinae

29. *Heterotermes ceylonicus* (Holmgren)
30. *Heterotermes gertrudae* Roonwal
31. *Heterotermes indicola* (Wasmann)
32. *Heterotermes malabaricus* Snyder
33. *Reticulitermes chinensis* Snyder

Subfamily (ii) Stylotermitinae

34. *Stylotermes fletcheri* Holmgren & Holmgren

Subfamily (iii) Coptotermitinae

35. *Coptotermes ceylonicus* Holmgren
36. *Coptotermes emersoni* Ahmad
37. *Coptotermes formosanus* Shiraki (*nec* Holmgren)
38. *Coptotermes gaurii* Roonwal & Krishna (*exiguus* auct.)
39. *Coptotermes gestroi* Wasmann
40. *Coptotermes heimi* (Wasmann) (syn. *C. parvulus* Holmgren)
41. *Coptotermes kishori* Roonwal & Chhotani
42. *Coptotermes travians* Haviland

(b) Species which do not commonly inhabit wood but attack and destroy it

Family IV. TERMITIDAE

Subfamily (i) Amitermitinae

43. *Globitermes audax* Silvestri (syn. *G. birmanicus* Snyder)
44. *Microcerotermes annandalei* Silvestri
45. *Microcerotermes heimi* Wasmann

Subfamily (ii) Macrotermitinae

46. *Odontotermes bangalorensis* Holmgren
47. *Odontotermes brunneus* Holmgren
48. *Odontotermes ceylonicus* (Wasmann)
49. *Odontotermes feae* (Wasmann)
50. *Odontotermes horni* (Wasmann)
51. *Odontotermes obesus* (Rambur)
52. *Odontotermes parvidens* Holmgren & Holmgren

53. *Odontotermes redemanni* (Wasmann)
54. *Hypotermes obscuriceps* (Wasmann)
55. *Microtermes mycophagus* (Desneux)
56. *Microtermes obesi* Holmgren (syn. *M. anandi* Holmgren)

Subfamily (iii) Nasutitermitinae

57. *Nasutitermes ceylonicus* (Holmgren)
58. *Hospitalitermes birmanicus* (Snyder)